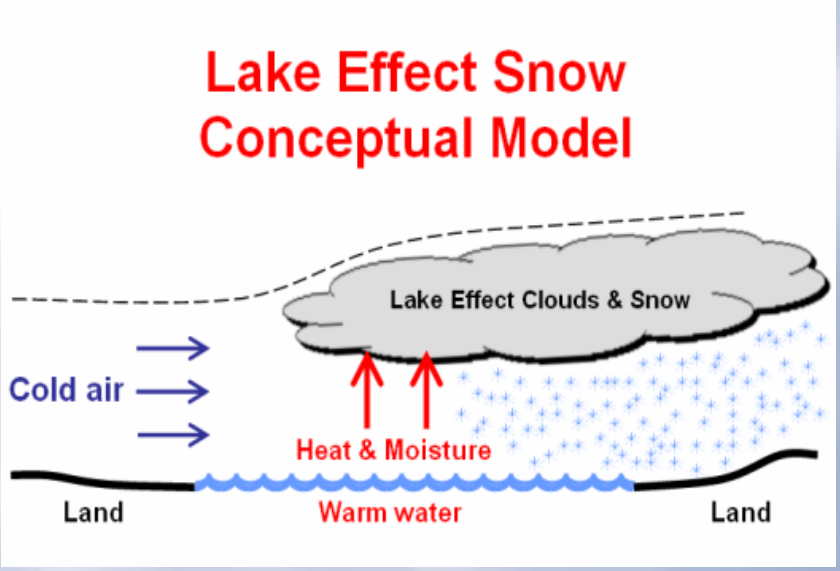
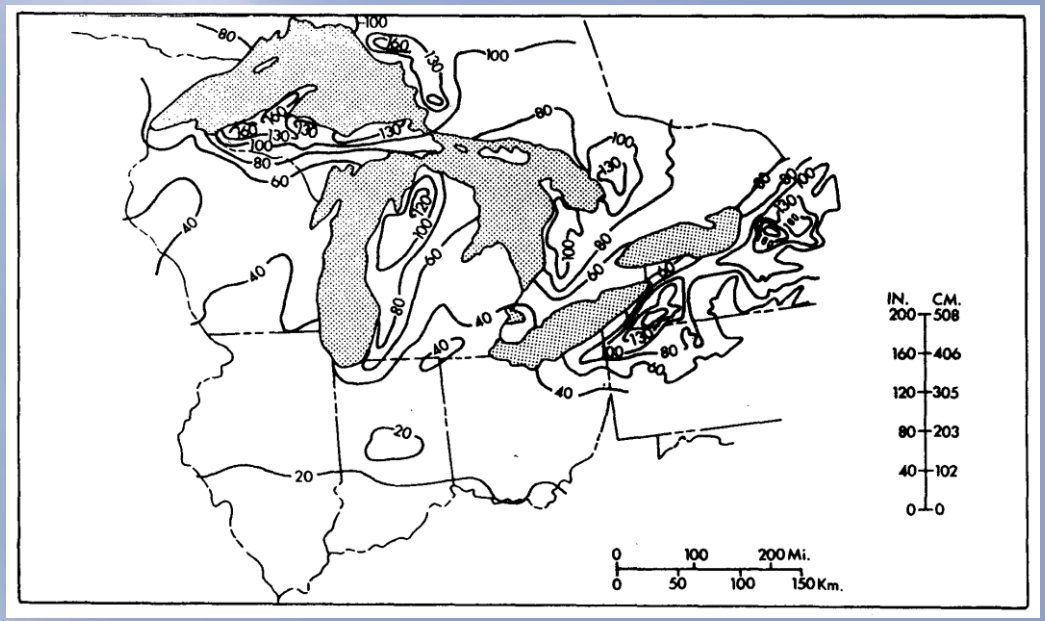
WARMER THAN NORMAL LAKE TEMPERATURES = MORE SNOW?

The Premise…

- Lake Effect snow is caused by cold polar and arctic air masses moving over the warmer waters of the Great Lakes.



Mean Annual Snowfall (in)



The Premise…

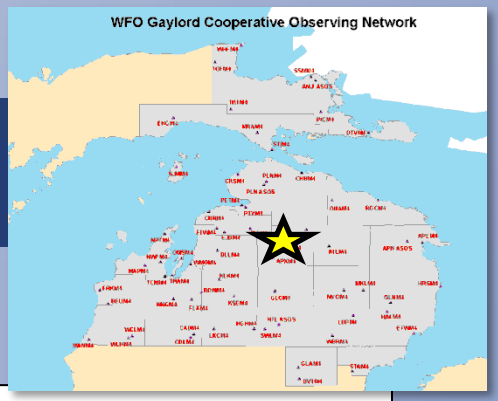
- Heat and moisture flux from the water to the air is directly related to the air/water temperature difference

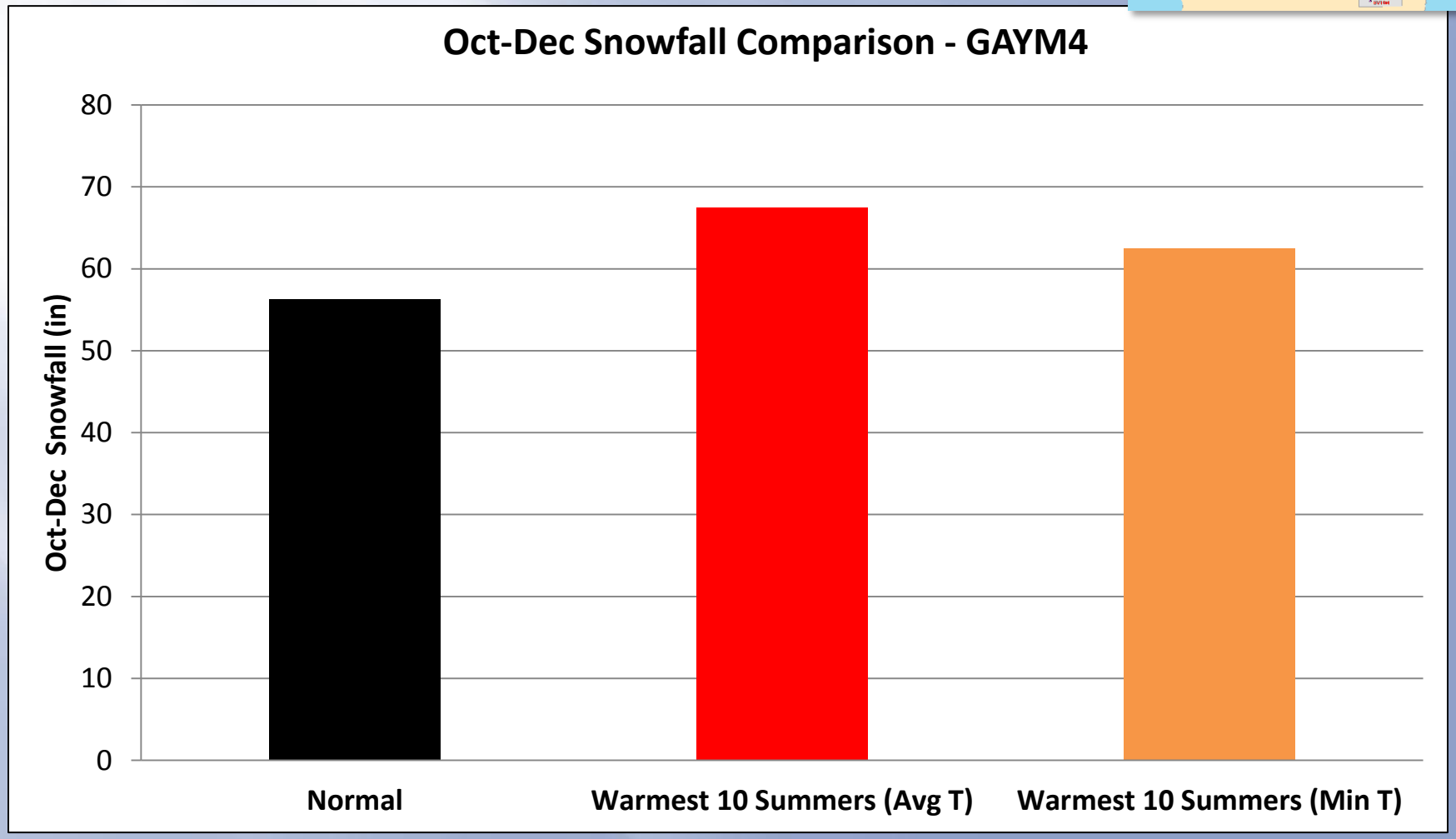
- So, if fall lake temperatures are warmer than normal, shouldn't there be a greater heat/moisture flux and therefore more snow?

Let's Look at Some Data:

- The Study:
  - Examine snowfall for years when the Great Lakes were warmer than normal
    - No complete source of long term Great Lakes water temperature data
    - Do have good long term temperature/snowfall records
    - Try a few assumptions
      - Warmer summer temperatures ~= Warmer lake waters?
      - Warmer summer nighttime temperatures?
  - For this study, examine the top 10 "warmest" summers and then snow the following "fall" (Oct-Dec) and entire winter season (Oct-Apr)

Results – Gaylord, MI





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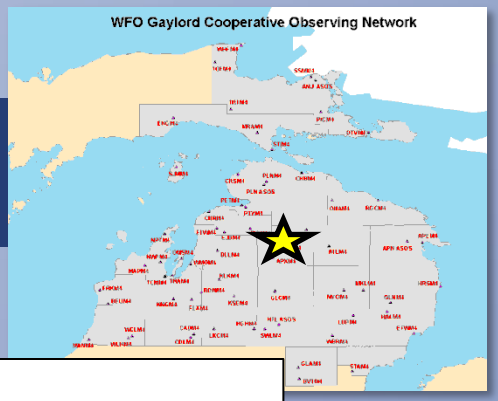
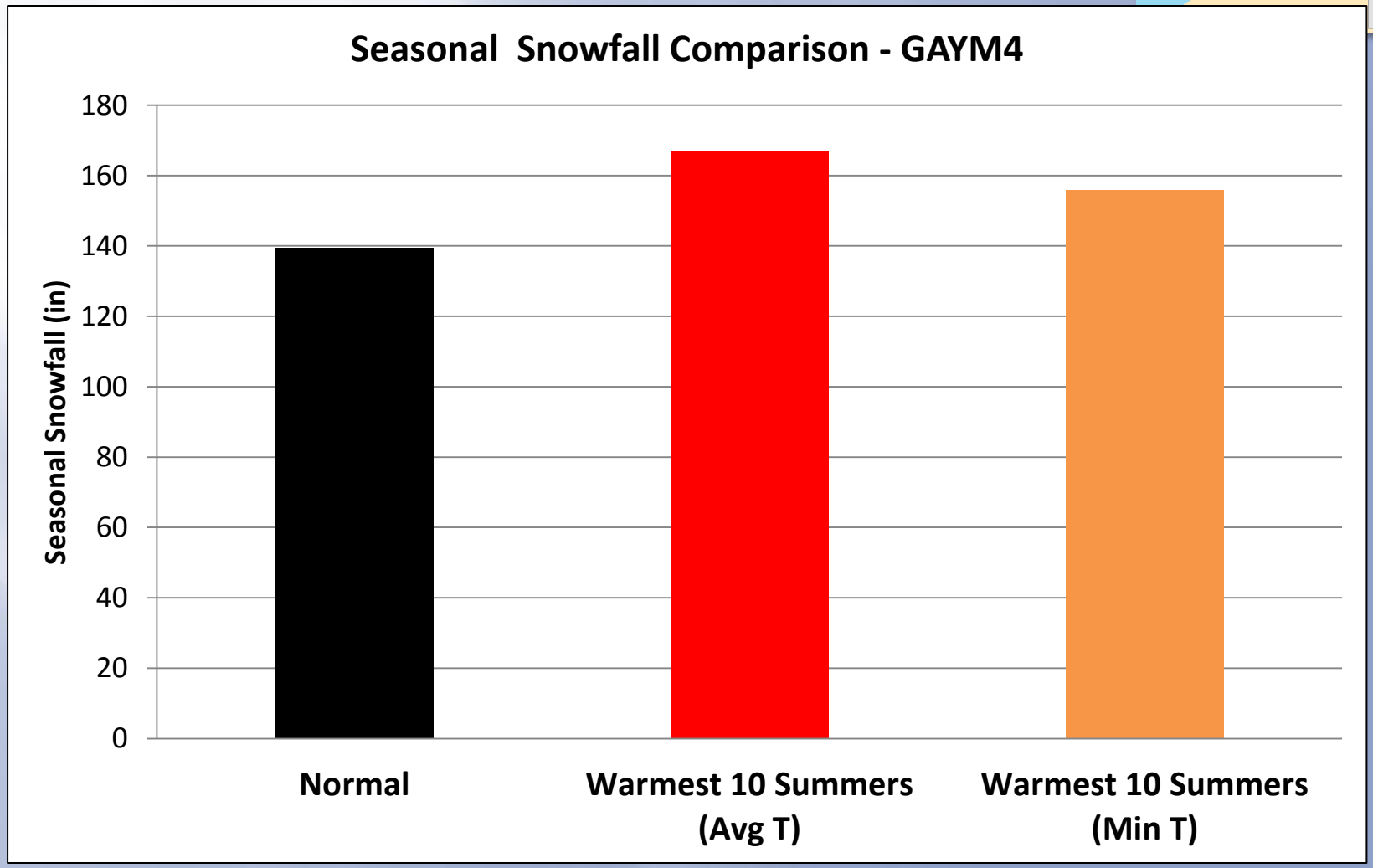
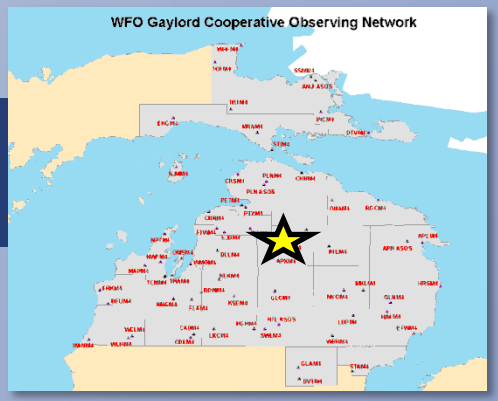




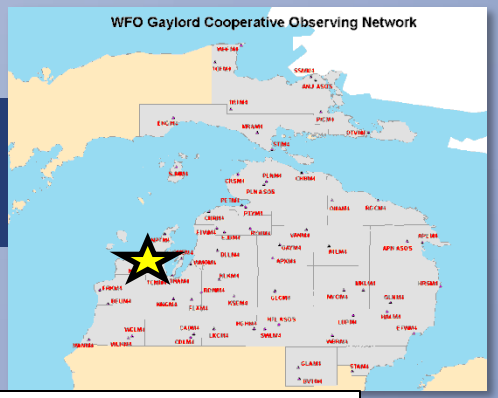
Summary – Gaylord, MI

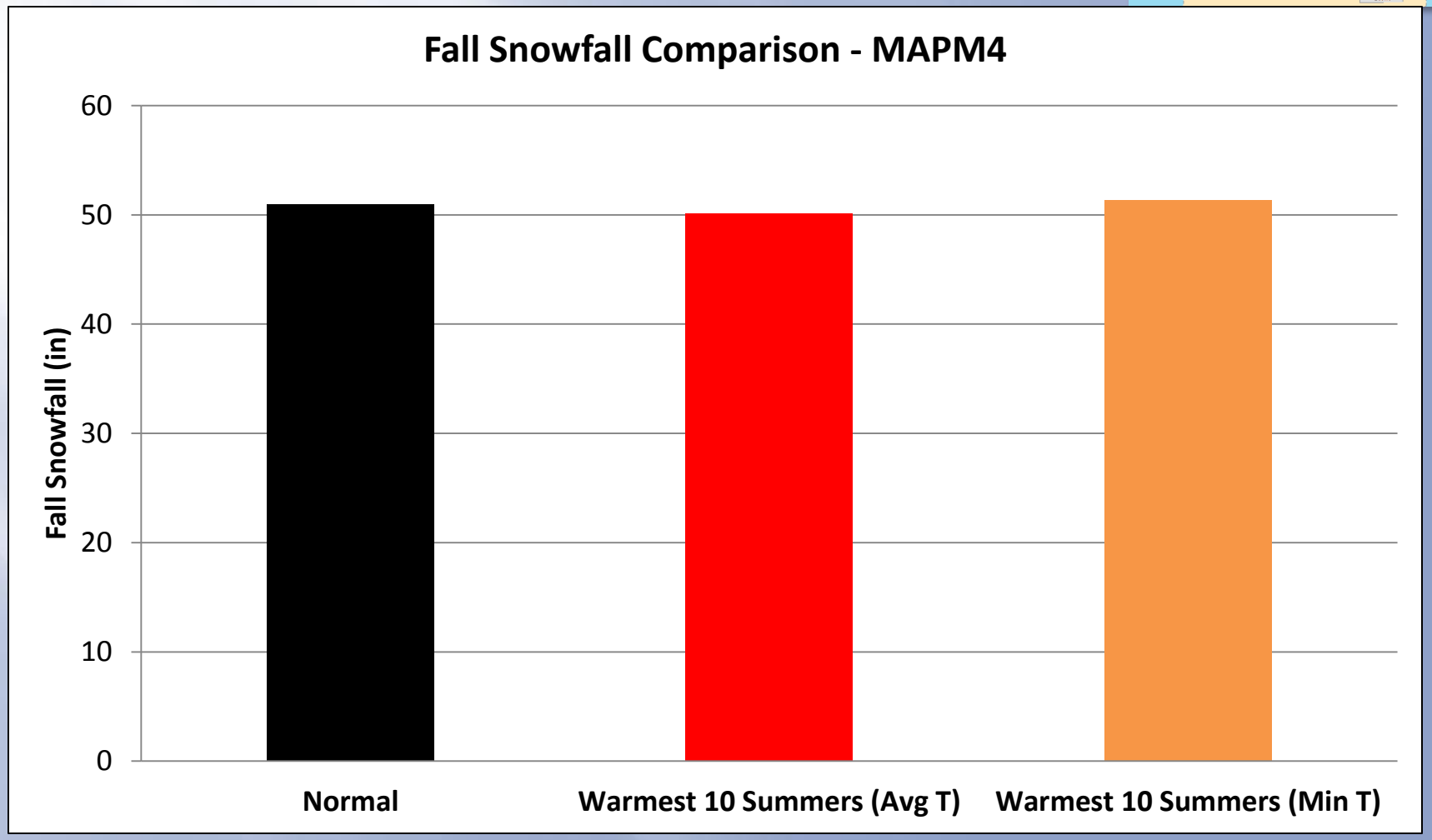


- **Warm Summers → Warmer lakes → More Snow?**
- **7 (6 using MinT) out of the 10 warmest summers were followed by more than normal fall snowfall**
- **9 (8 using MinT) out of the 10 warmest summers were followed by more than normal seasonal snowfall**

Could we be on to something?

Results – Maple City, MI





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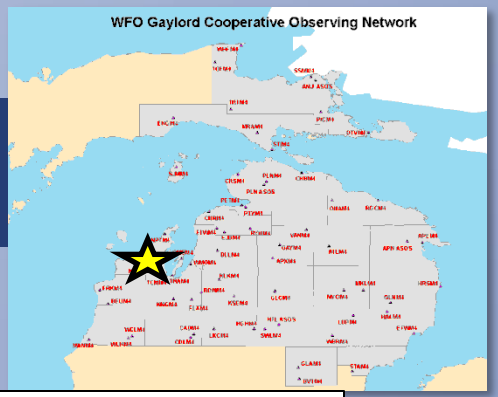
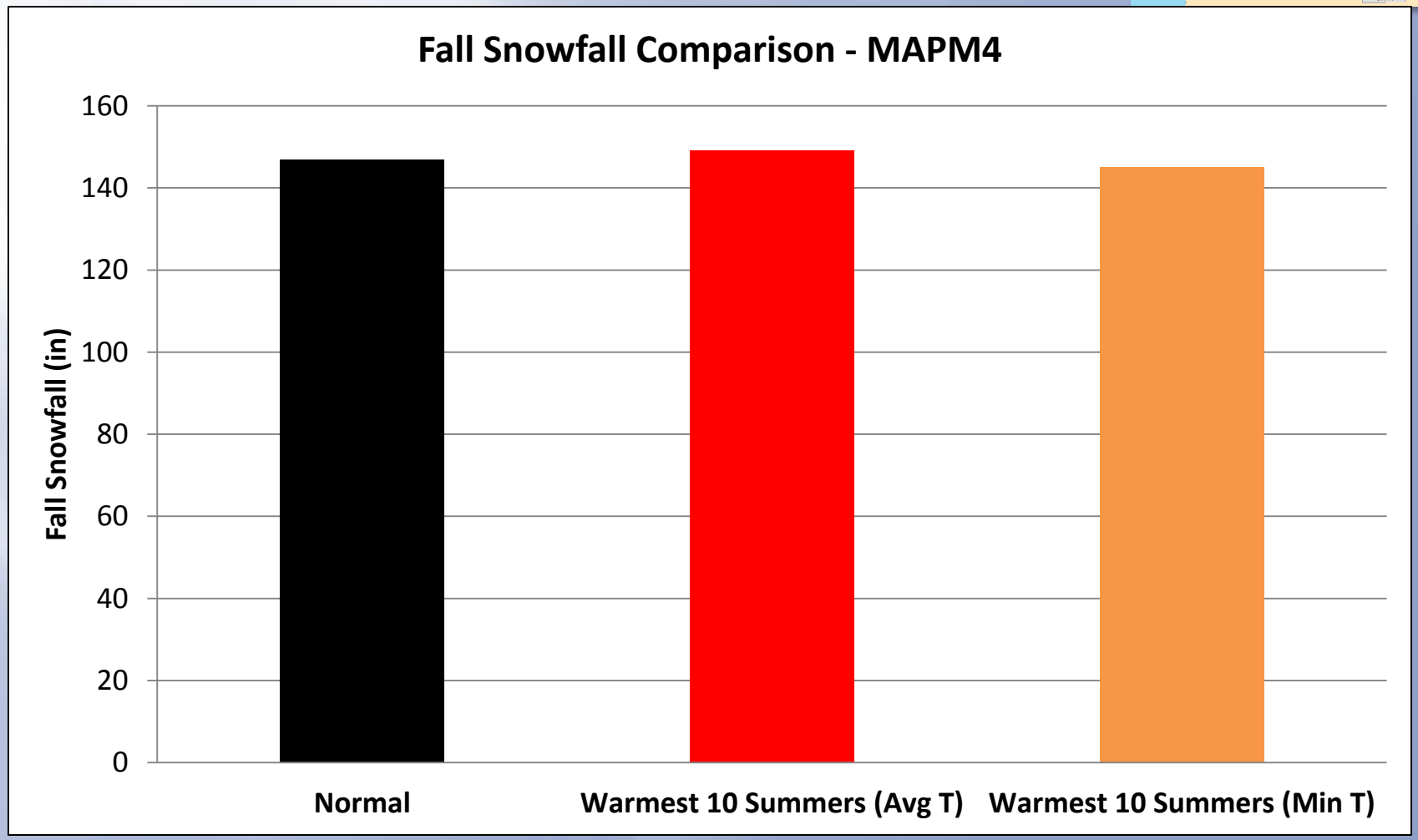
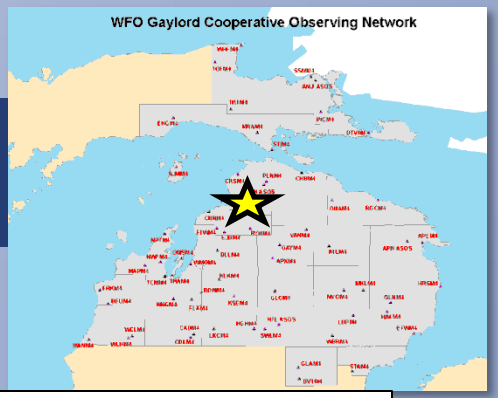


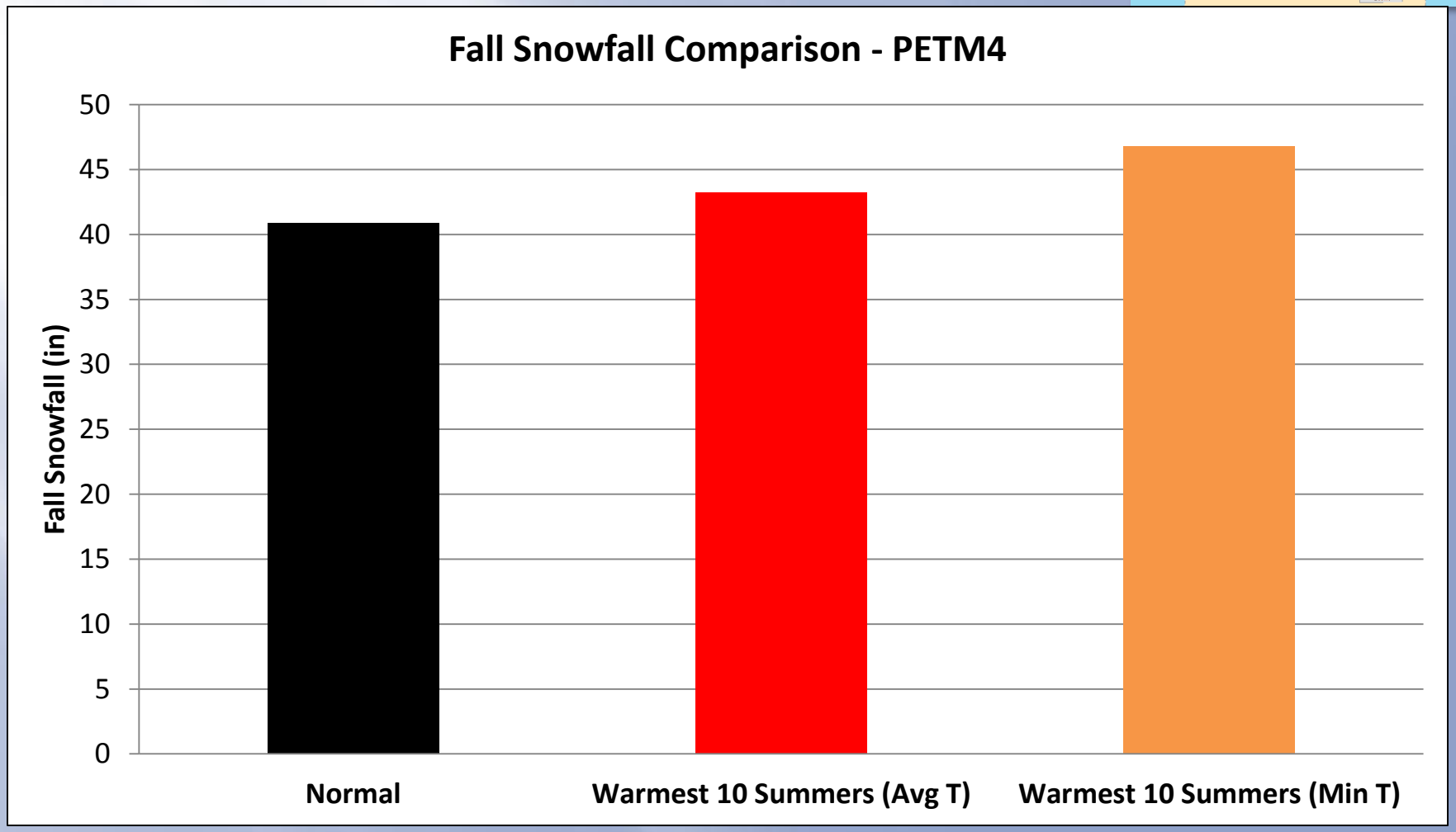


Summary – Maple City, MI

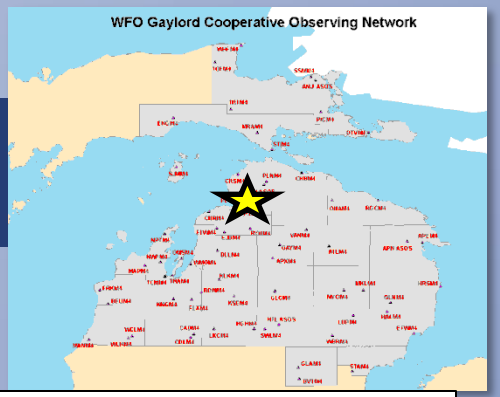
- **Uh oh…No Correlation!**
- **5 (5 using MinT) out of the 10 warmest summers were followed by more than normal fall snowfall**
- **5 (4 using MinT) out of the 10 warmest summers were followed by more than normal seasonal snowfall**

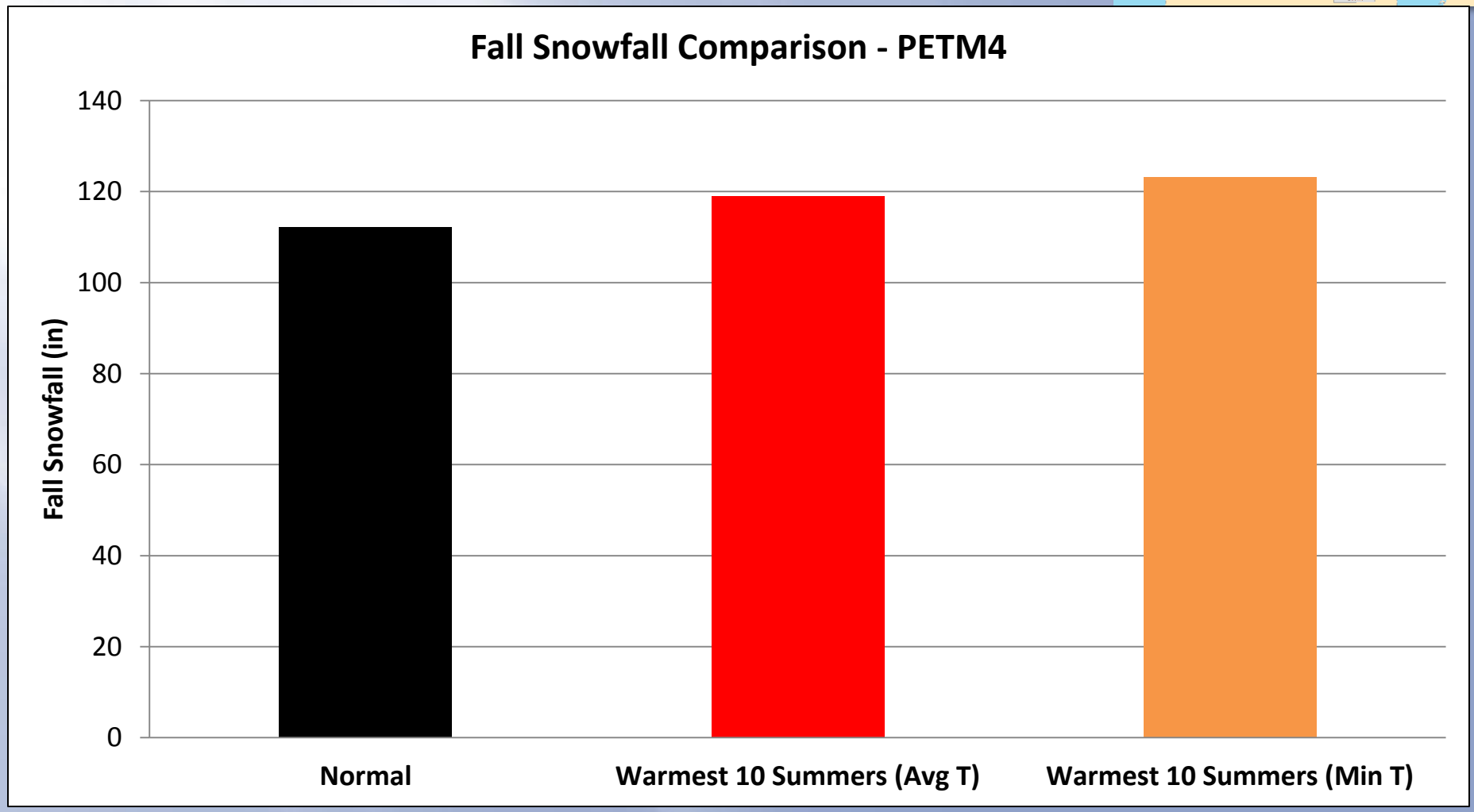
Results – Petoskey, MI





Results – Petoskey, MI





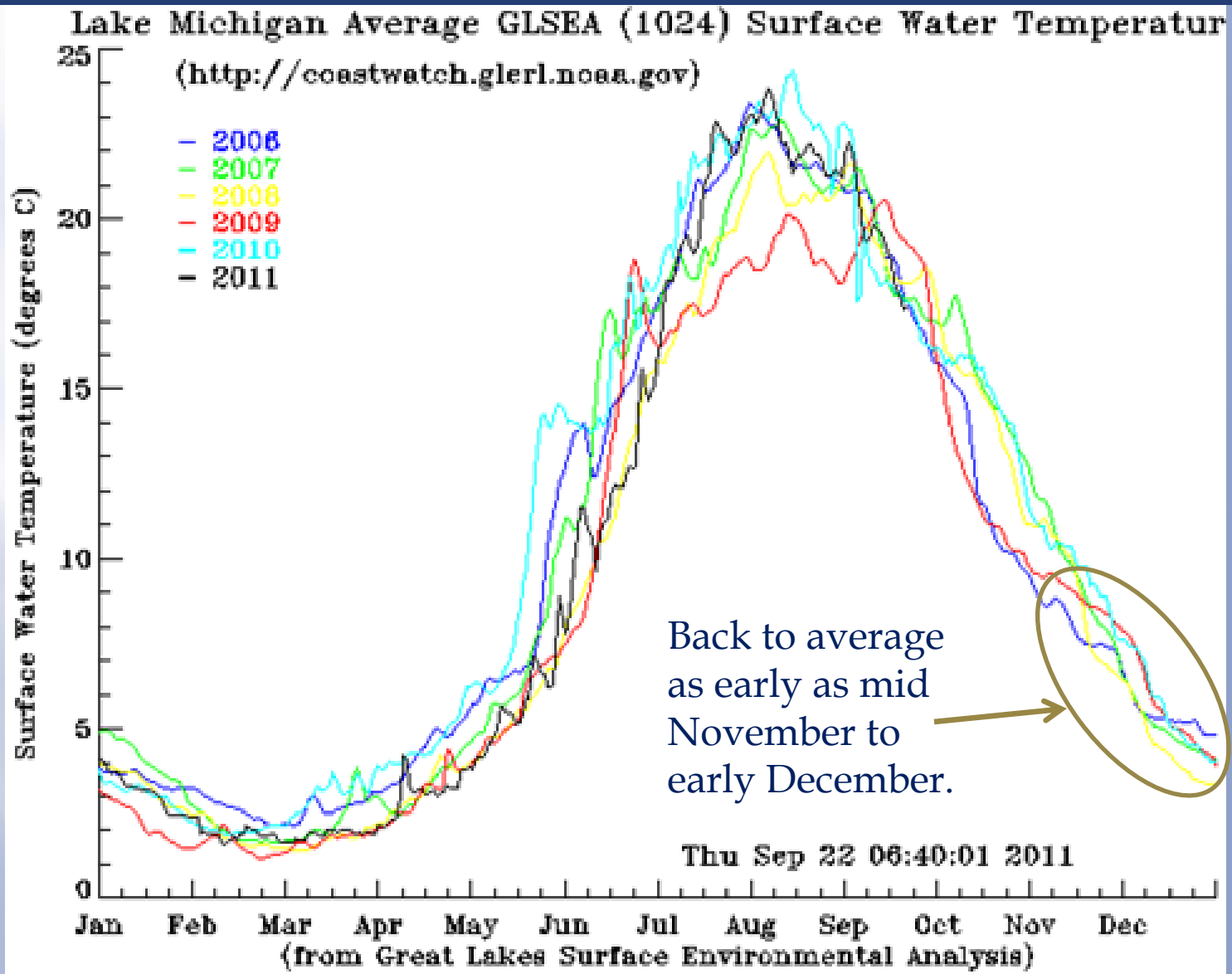
Summary – Petoskey, MI

- **Weak/No Correlation**
- **4 (4 using MinT) out of the 10 warmest summers were followed by more than normal fall snowfall**
- **7 (6 using MinT) out of the 10 warmest summers were followed by more than normal seasonal snowfall**

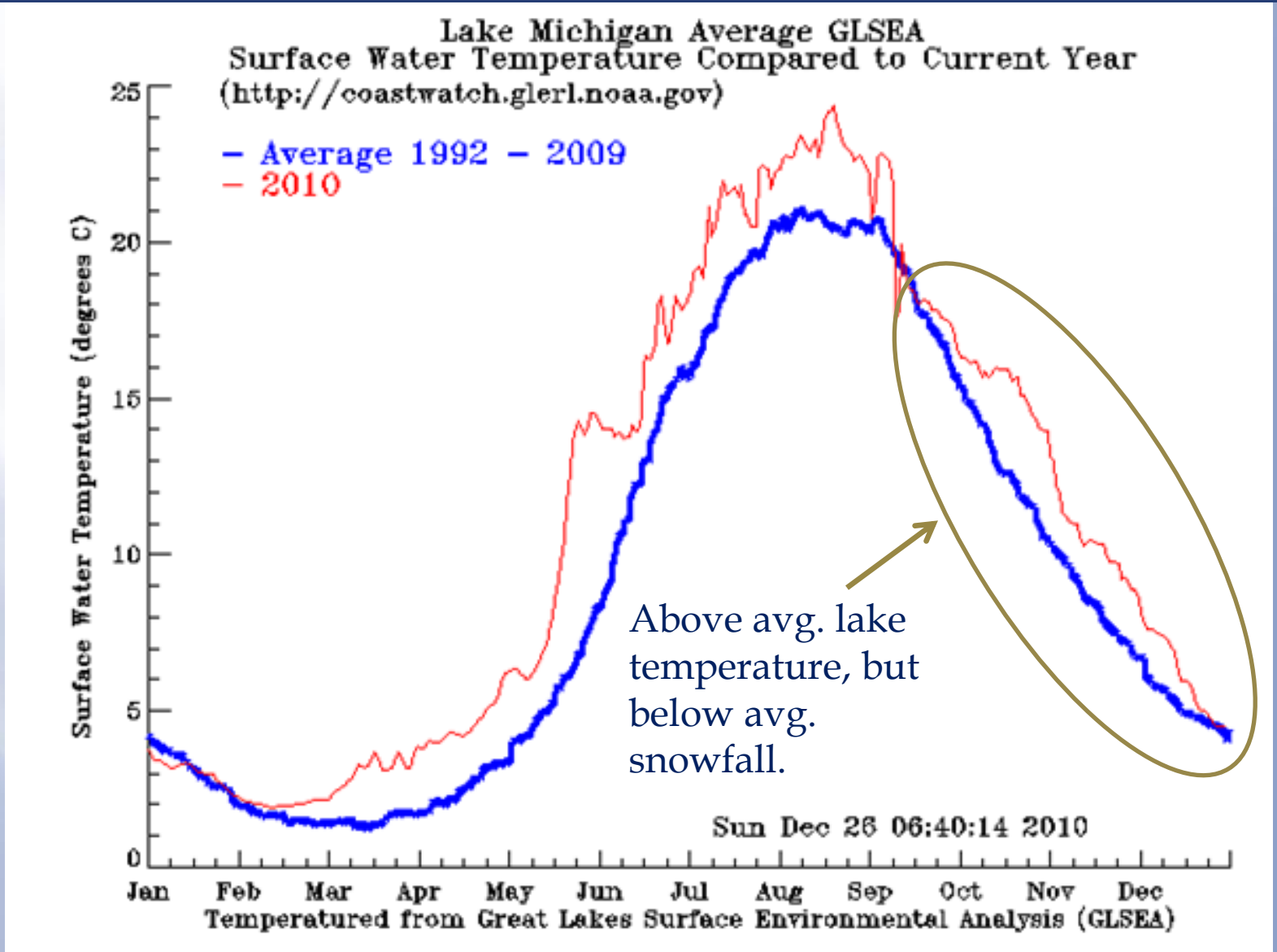
Study Summary

- Despite evidence of a link at Gaylord, there is little correlation between fall/seasonal snow at Maple City and Petoskey and previous summer lake temperatures
- What else could be at work?

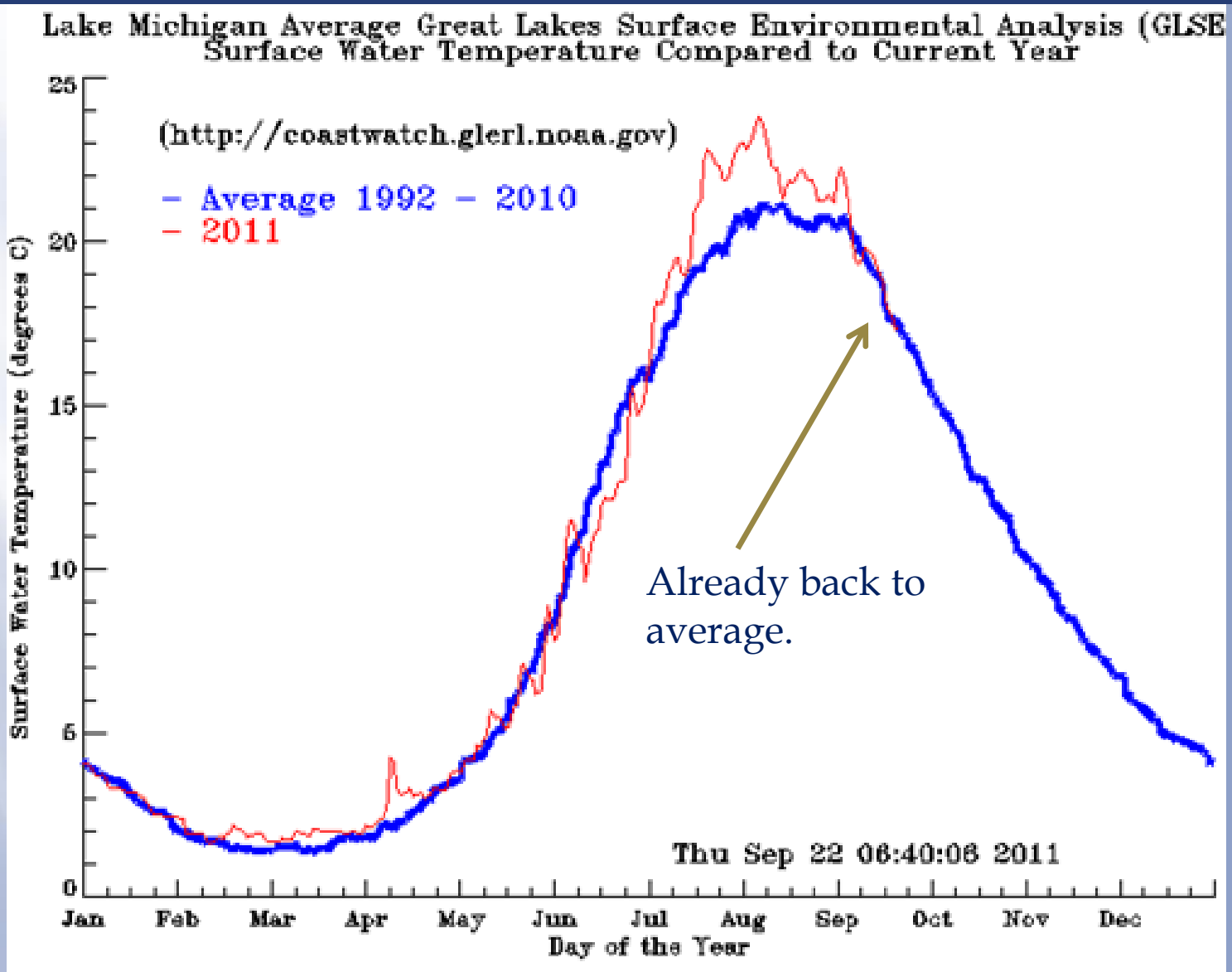
2006 to 2011 Lake Michigan Temperatures:



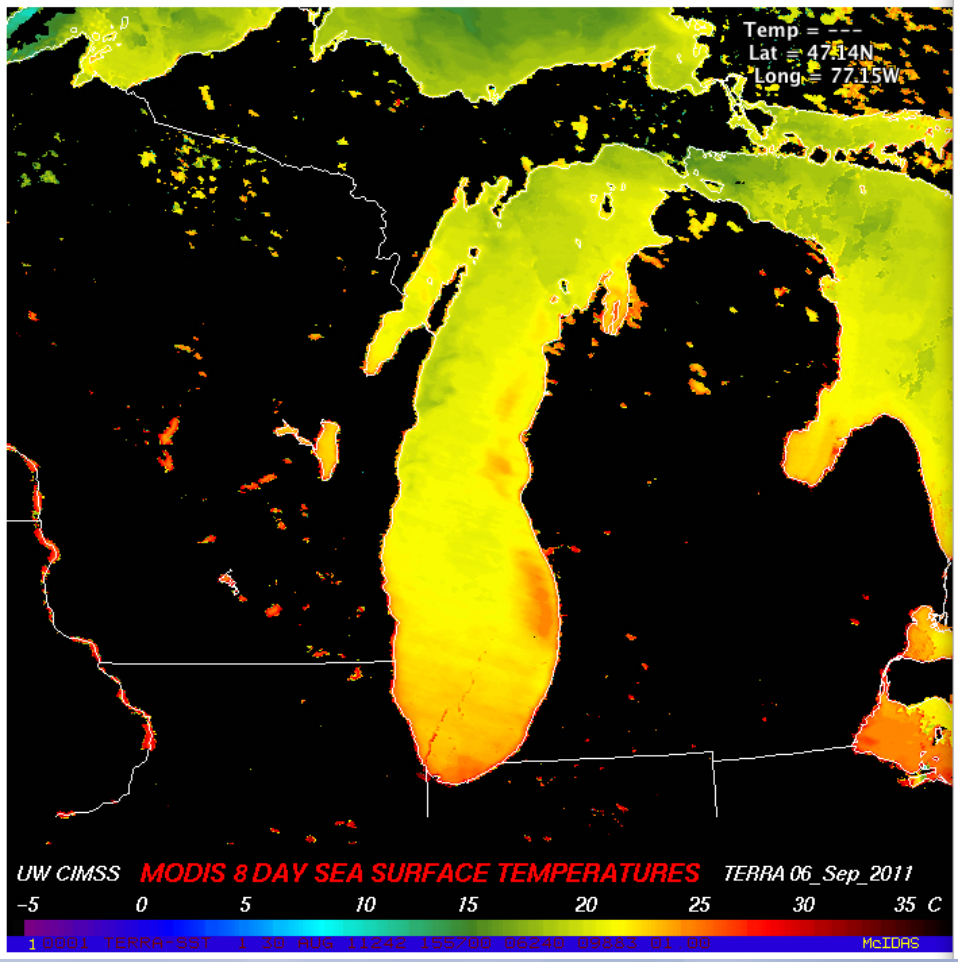
2010 Temperature compared to 1992 to 2009 average:

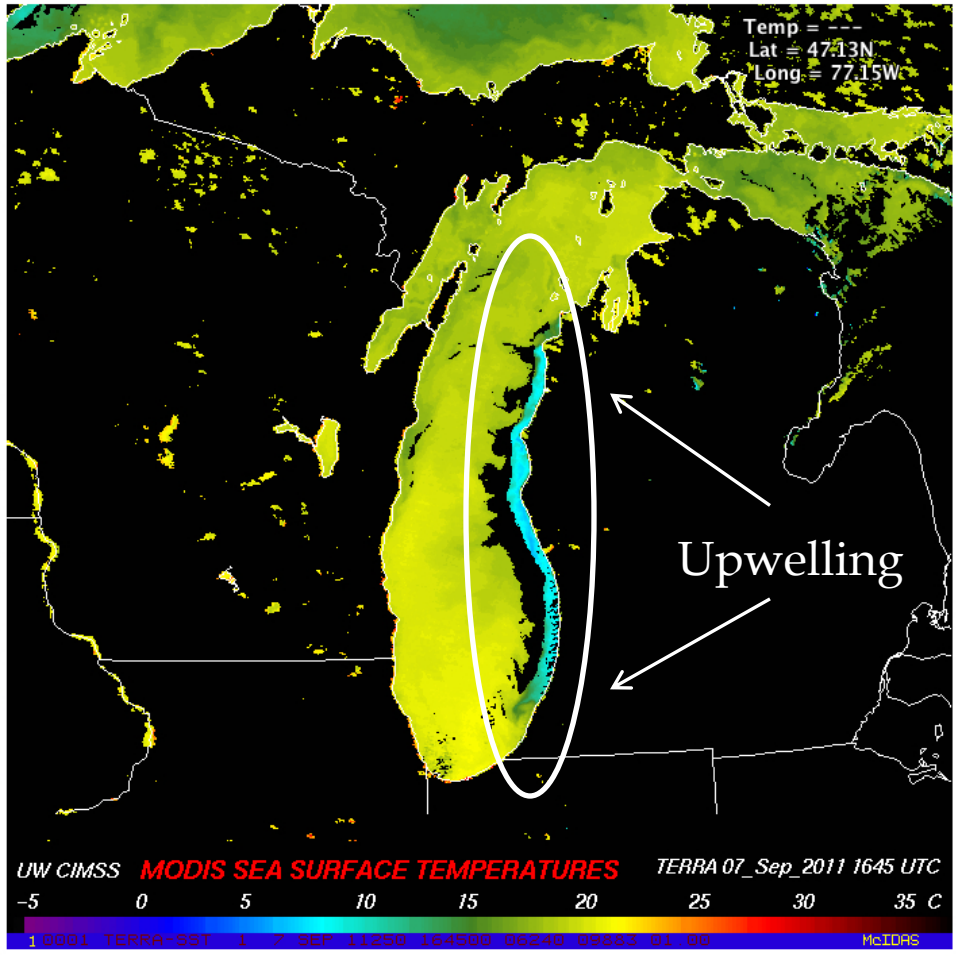


2011 Temperature compared to 1992 to 2009 average:



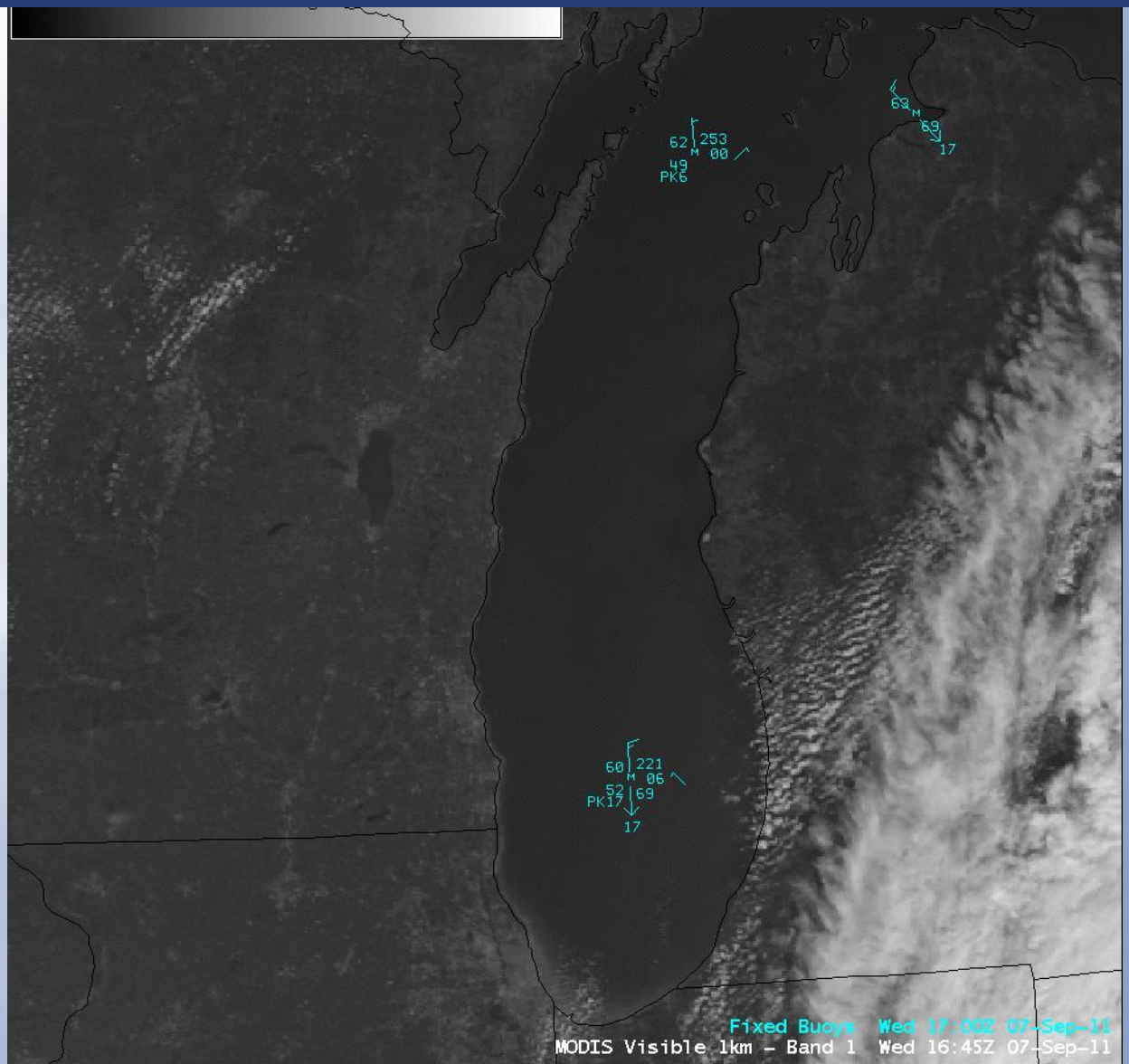
Lake Michigan temperature change after a day of strong northeast winds :





One location went from 73° F to only 44° F !

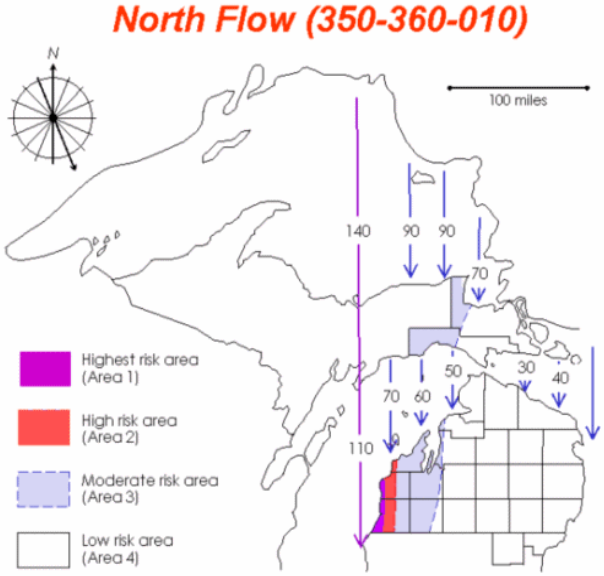
Visible and Infrared satellite:

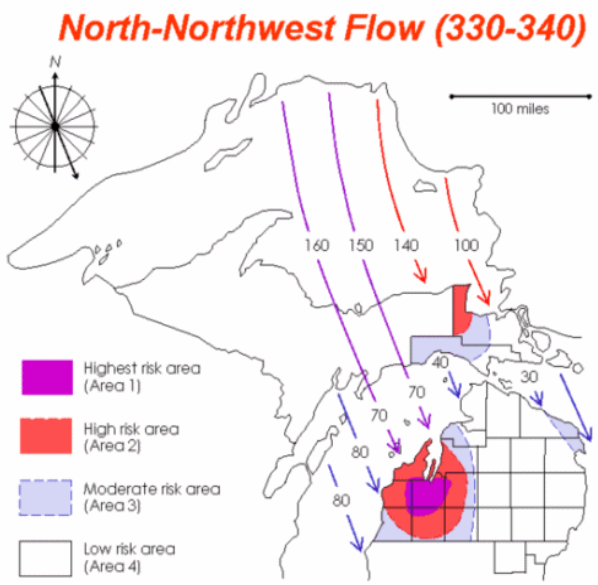


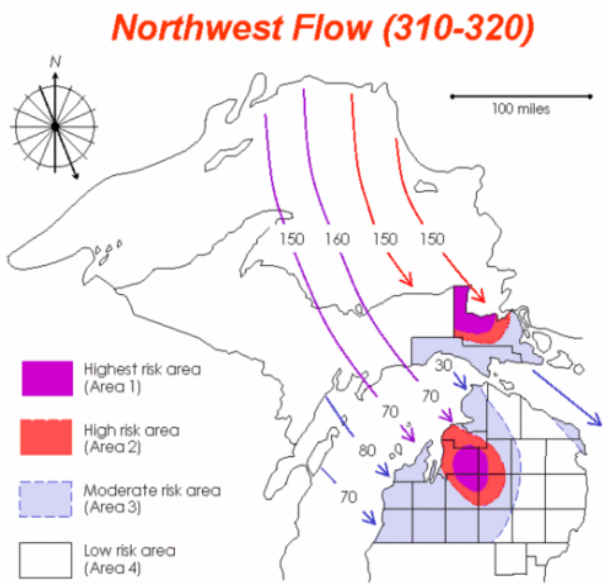
Other Variables

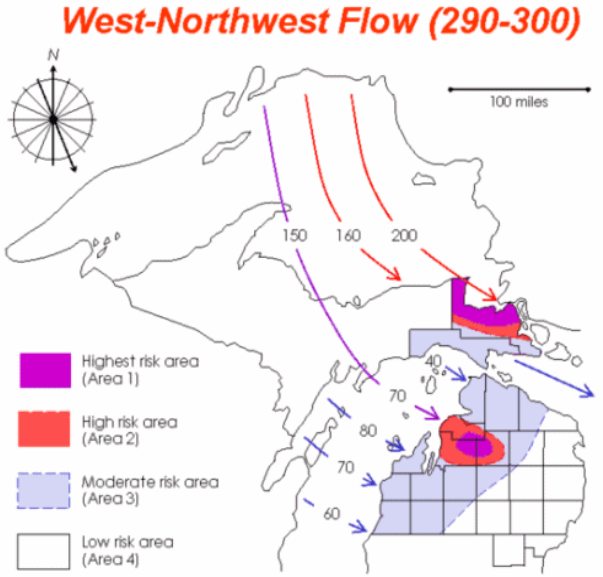
- Water temperatures can drop rapidly, negating any summertime warmth. What else governs lake effect snow amounts?
  - Wind
  - Air Temperature

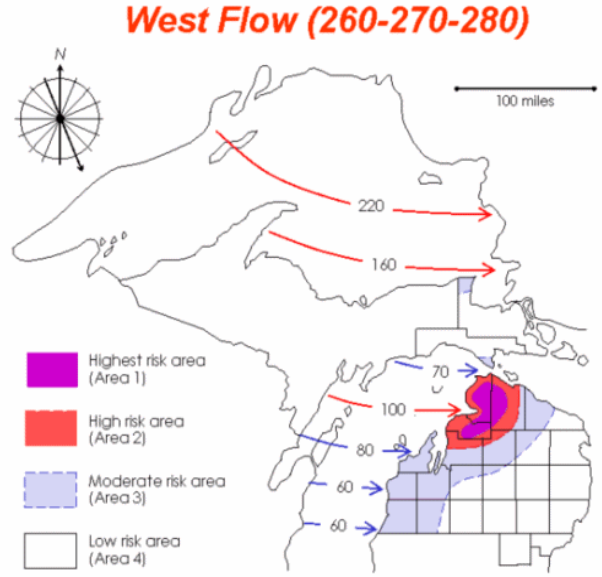
Other Impacts on LES - Wind

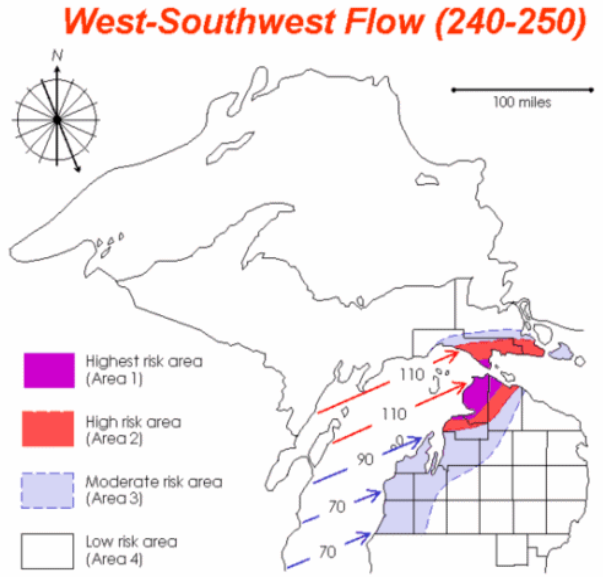




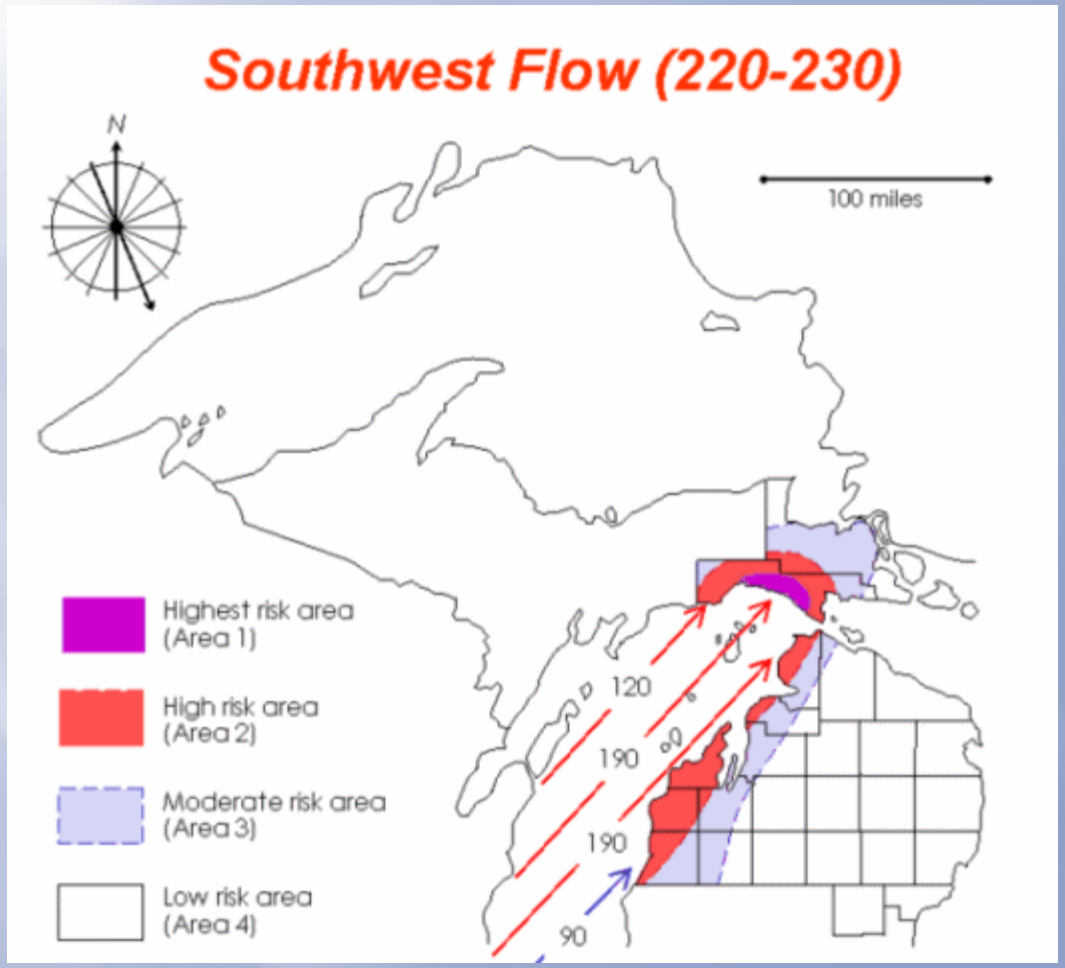








Other Impacts on LES - Wind



Other Impacts on LES – Air Temperature

- For Lake Effect Snowfall
  - Temperature (lake) – Temperature (5000 feet) ~ 13C or more
- Year to year lake surface temperatures vary by no more than about 7C.
- Temperatures at 5000 feet vary by as much as 40C (from-20° C to +20° C)
  - Due to changing weather patterns

Conclusions:

- Overall, wind and air temperatures (i.e. weather patterns) have a much larger impact on lake effect than lake water temperatures
  - Note the early 2010-2011 snow season in Gaylord
- Warmer lakes could produce a stronger early season event
  - Could be rain at the coast
  - Lake temperatures will drop rapidly

Overall Conclusion: More myth than truth!

References

- Niziol et al. 1995, Winter Weather Forecasting throughout the Eastern United States. Part IV: Lake Effect Snow., Weather and Forecasting

- NOAA Coastwatch: http://coastwatch.glerl.noaa.gov/